

### Appendix 3 - State forest harvest, as programmed

The state forest harvest treats stand data similarly to the FPA harvest (Appendix 4) except that tree distances are measured as horizontal distance from the stream. Within this program, trees are preferentially retained closest to the streams within RMA zones. The structure of the harvest simulation differs from the FPA harvest in that the inner zone is first assessed to determine if the stand meets mature forest condition (MFC). Then the stand data are passed on to functions to simulate harvest in the inner zone and the outer zone (did not meet MFC) or just the outer zone (MFC achieved).

The approach for this simulated harvest was gleaned from Appendix J and Appendix C of the Northwest Oregon Forest Management Plan as well as from communications with State Forest employees. RipStream vegetation data are well-suited for applying Appendix J to, although there are some data limitations. Limitations, assumptions, and decisions include:

- Only have data for trees >6" DBH
- Only have crown class/height information for roughly 1/5 of trees
- Will determine SDI only for conifer species >8" DBH, see table J-1 in NWFMP. This diameter best matches my understanding of how field offices calculate SDI for their stands.
- All hardwoods within 100' of streams in all stands will be retained.
- SDI is a mixed-species approach, and I sum % SDI by conifer species
- There are two conifer MFC criteria, it appears. The first is that there needs to be 220 square feet of 11" conifer basal area/acre in the inner zone. Later on, when figuring out how many trees to retain in the outer RMA zone, it defines a MFC of having >45 11" conifer TPA in the inner zone (first 100'). 45 11" trees = 119 square feet. Therefore it does not appear that the two measures are equivalent. The first value is calculated to determine if the inner zone receives harvest. Next, regardless of selected harvest, the second MFC (>45 11" conifer/ac) is applied to determine outer zone retention.
- In outer zone, we select conifers for retention based on size, in order from largest to smallest. Regardless of distance from the stream, the largest are retained (between 8 & 35 per 500')
- If MFC is attained because the stand is hardwood dominated, then the outer zone has 8 conifers retained + the deficit number. If MFC is achieved with large conifers, then the outer zone MFC is set to 8 (it would be 15 if 1000' of stream).
- When calculating SDI, we count unknown conifer species as "DF."

**Table J-1. Management Standards for Type F Stream RMAs**

All Stream Sizes: Large, Medium, and Small	
Stream bank zone 0-25 ft.	<ul style="list-style-type: none"> <li>• No harvest.</li> <li>• Less than 10% vegetative disturbance.</li> <li>• Full suspension required during cable yarding.</li> <li>• No ground-based equipment operation.</li> <li>• Leave any trees damaged or felled from yarding activities.</li> </ul>
Inner RMA zone 25 to 100 ft.	<ul style="list-style-type: none"> <li>• Manage for mature forest condition.<sup>1</sup></li> <li>• No management activity where mature forest condition (MFC) exists, or where conditions are suitable for development of MFC in a reasonable time frame without further treatment.</li> <li>• Actively manage where necessary to achieve the desired future condition in a timely manner.</li> <li>• Minimum 15-year interval between harvest entries, and minimum number of entries necessary to achieve the desired future condition.</li> <li>• Partial cutting will maintain a conifer density of at least SDI 25%, and will retain at least 50 TPA.</li> <li>• No more than 10% vegetative disturbance allowed from cable yarding.</li> <li>• Full suspension wherever possible, or one-end suspension on all cable-yarded material.</li> <li>• Ground-based equipment operation limited to area more than 50 ft. from aquatic zone and slopes less than 35%, and allowed on no more than 10% of area.</li> <li>• Leave any trees damaged or felled from yarding activities and additional felled, girdled or topped trees to contribute toward down wood targets.<sup>2</sup></li> <li>• Retain all dead and down material that was present prior to the operation.</li> </ul>
Outer RMA zone 100 to 170 ft.	<ul style="list-style-type: none"> <li>• Retain at least 10 to 45<sup>3</sup> conifer trees and snags per acre (15 to 70 trees per 1,000 ft. of RMA).<sup>4</sup></li> <li>• Retain all snags as safety permits.</li> <li>• Less than 10% ground disturbance from yarding activities.</li> <li>• Retain all dead and down material that was present prior to the operation.</li> </ul>

1. Desired mature forest condition consists of a stand dominated by large conifer trees, or where hardwood-dominated conditions are expected to be the natural plant community, a mature hardwood/shrub community. For conifer stands, this equates to a basal area of 220 square feet or more per acre, inclusive of all conifers over 11 inches DBH. At a mature age (80-100 years or greater), this equals 40-45 conifer trees 32 inches in DBH per acre.
2. Up to 10 trees per acre will be retained as felled, girdled, or topped trees during partial cutting, to reach a target of 600-900 cubic feet per acre of hard down wood.
3. Outer zone tree retention target will be increased when less than the target number of conifers is present in the inner zone. The process for calculating the outer zone retention target is described in the section following the RMA prescription tables.
4. All trees retained will be dominant or co-dominant conifer trees (if available). In order to balance the need for short-term and long-term recruitment of large wood to the aquatic zone, preference will be given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.

Table J1 from the NWFMP

From Appendix J, page 11, NWFMP:

## **Increasing Outer Zone Conifer Retention on Type F Streams**

*On Type F streams, in situations where the number of conifers available for retention within the inner zone is not adequate to achieve the large wood delivery potential of a mature forest condition, additional conifers will be retained in the outer zone to provide additional large wood recruitment potential.*

*This additional outer zone target will apply when the number of conifers of suitable size (11 inches or greater DBH) in the inner zone is less than the mature forest condition target of 45 TPA (100 trees per 1,000 lineal feet of stream for a 100-foot inner zone).*

*The number of additional conifers to be retained in the outer zone will be equal to the deficit from the inner zone target, adjusted to account for the different widths of the zones. For example, if the inner zone has an average of 70 suitable conifers per 1,000 feet of stream, then the additional retention level for the outer zone would equal 30 times 0.7, or an additional 21 conifers per 1,000 feet of outer zone.*

*In no case shall the number of conifers required to be retained in the outer zone exceed the inner zone target for mature forest condition. This means no more than 70 conifers per 1,000 feet of outer zone or 45 TPA are required. In addition, no trees shall be required to be retained in the outer zone in locations where, due to topography, they would have no opportunity to reach the area within the channel migration zone and thus potentially function as large wood in the stream channel. All conifers retained under this strategy shall meet the conifer retention criteria as described in footnotes to Tables J-1 and J-2: dominant or co-dominant trees, with preference given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.*

Following table J1 and instructions on increasing outer-zone conifer retention on F streams, we altered the pre-harvest stand data according to the following:

### **Data Preparation**

Pre-harvest vegetation plot data are first cleaned to make sure only trees with DBH  $\geq 6$ " and with horizontal distances  $\leq 170$  are included. Then the data are reduced to a single plot. All trees are given a rank by distance. Distances are minutely and randomly adjusted to break ties.

The next step is to determine if stands are at MFC (either hardwood or conifer) or not. Conifer MFC is relatively easy to determine. It is the sum of all living conifer basal area between 25 & 100' from the stream (inner zone) with a DBH  $\geq 11$ ". This amount is converted to an acreage value and compared against the target (220 ft<sup>2</sup>/ac).

The data are also passed to the function HW\_DOMINATION to determine if hardwood dominated (described below). If the plot is either conifer or hardwood dominated, the tree data are passed to the function MFC\_PATH in which no harvest happens in the inner zone. If not hardwood or conifer dominated, then data are passed to the function SDI\_PATH, which determines harvest levels in the inner and outer zone.

## **HW\_DOMINATION**

The following description of hardwood stands is found in Appendix C, page 15, of the NWFMP.

### ***Hardwoods***

*Hardwood stands are classified along with conifer stands in one of the five stand structure types. However, for the purpose of facilitating discussion, hardwood stands are defined as those stands where hardwood tree species comprise more than 70 percent of the tree canopy. Seventy percent is a subjectively set measure that identifies when the hardwood canopy is the dominant vegetative feature that characterizes the stand tree canopy and thus will likely control the focus of stand management practices. Seventy percent is also being used to identify hardwood stands by current research such as the “Coastal Landscape Analysis and Modeling Study” (CLAMS) (Tom Spies 1996). Common hardwood tree species include red alder, bigleaf maple, and Oregon white oak.*

*Field managers may choose to manage hardwood stands on the landscapes for a variety of reasons, such as to obtain economic benefits from hardwood products, to manage tree diseases in the stand, or to introduce or maintain additional vegetative diversity within conifer-dominated landscapes.*

*At this time it is assumed that a small percentage (probably 10 percent or less) of the landscape will be managed as hardwood stands. Maintaining a component of hardwoods within conifer stands is encouraged and it is anticipated that most stands will have some hardwoods. Implementation plans will better estimate how much of the landscape currently consists of hardwood stands and what portions of the landscape may be managed as hardwood stands in the future. If managers determine it is desirable to manage greater portions of the landscape in hardwoods, the forest management plan may have to be adjusted.*

To determine if a plot is hardwood dominated, only the live trees in the inner zone (25-100') are considered. Hardwood dominated was interpreted as > 70% of the canopy. However, we do not have full canopy class (CC) information for our stands. Below is how we interpreted our stand data to determine hardwood dominance.

For inner zone, remove all snags, and create list of all trees with crown class of 4+ (intermediate, overtopped) and another list of trees with CC= 2, 3 (dominant, codominant).

For just the tree species that had dominant, codominant stems, stems were treated as canopy stems if DBH was greater than the maximum stem DBH for intermediate/overtopped trees of that species. Or, if all measured stems were in the canopy, we included all stems that were greater than the minimum-sized CC 2,3 stem for that species.

For all identified “canopy” stems we determined the fraction of those stems that were hardwood. If that fraction was  $\geq 0.7$  the stand was coded as hardwood-dominant (1) and therefore MFC was reached. If not, it was coded a zero (0). This value was passed back to the Data Preparation step to contribute towards determining the destination of the data (functions MFC\_PATH or SDI\_PATH).

### **MFC\_PATH**

If the site’s inner RMA zone is at MFC

Keep all trees  $\leq 100'$  from stream

Determine if secondary conifer MFC condition met (100 trees/1000' DBH  $\geq 11''$ )

- a. If condition met, the 8 largest (DBH) conifer trees in outer zone are retained, all else harvested
- b. If condition not met, determine the number of trees short of the secondary MFC. The number must be  $\leq 35$  trees/500' and 8 or greater.

Send plot information to the **Plot Summarization** function

### **SDI\_PATH**

If RMA zone not at MFC, then determine amount of conifer to be harvested according to SDI.

Compile a stand list of conifers (one plot). The list is sorted by distance from stream.

The inner zone is defined as  $>25, <101$  feet

For each tree over 11" DBH, the SDI is calculated

- a. A blank table is created with columns = conifer tree species
- b. Cycling through each tree in the inner zone, the SDI table is updated. The number of trees/tpa for that species is increased, as is the cumulative basal area for that species. These numbers are used to calculate the QMD and SDI for that species. Then, the SDI is compared against the maximum SDI for that species to produce the percentage SDI achieved by that species. The percentages for all tree species are totaled and recorded as a cumulative value for the target tree.
- c.  $QMD = \sqrt{BA/(k*n)}$ , where BA = stand basal area, k in square feet = 0.005454, and n = number of trees
- d.  $SDI = tpa*(QMD/10)^{1.605}$

Trees are marked in the inner zone as needing to be kept (in order of distance from the stream) if the  $SDI < 0.25$  and there are less than 50 tpa (59 trees for a 500'\*75' plot). The program is set to keep all 8+'' trees that contribute to SDI, selected in order by distance from the stream. Trees contributing to the SDI are spared, as are additional trees needed to reach the 50 tpa target. If the SDI is met but fewer than 50 tpa have been retained, 8+'' trees are retained preferentially over smaller trees. If smaller trees are needed to meet the 50 tpa target, they will be retained starting from the 25' distance. All other conifers will be removed.

- a) The tpa measure can be met with  $<8''$  trees, although this is anticipated to be rare since it would take a number of large conifers to have the SDI reach 25% but not 50 TPA
- b) Once we reach SDI, a list of trees to keep is determined
  - a. Keep all trees within 25' from stream
  - b. Keep all hardwood within 100'
  - c. Keep all SDI/tpa selected conifers from inner zone (harvest the rest)
  - d. Keep selected conifers from outer zone as per step b in the function MFC\_Path.

Plot data are then sent to the **Plot Summarization** function; all trees (kept or otherwise) were passed on to the function **Tree Fate**.

### **Plot Summarization**

As in the FPA harvest simulation, Plot Summarization takes the appropriately-annotated vegetation plot data that passed through the MFC\_PATH or SDI\_PATH functions and summarizes the remaining basal area. Incoming data have been stripped of snags, as snags are not expected to contribute much to shade. The stand data trees are marked as “kept” = 1 or 0, to indicate that the tree is retained or harvested. Summarized data include (within 100’ horizontal distance of the stream, for all “kept” = 1 trees) the basal area of all trees, conifer trees, hardwood trees, all trees expressed in m<sup>2</sup>, the number of all trees, conifers, and hardwoods, and the distance to the retained trees farthest from the stream or (of the five vegetation plot lines) the mean and minimum of the maximum tree distance along each line.

The output file for Plot Summarization provides the information for each plot on a single line.

### **Tree Fate**

The Tree Fate function is a means for storing all of the tree data along with a column for “kept” trees. The idea is to be able to plot the retention patterns for each plot as needed.